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Stable isotope approach for estimating phreatic evaporation in irrigated lands of Ferghana Valley (Uzbekistan)

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Agriculture in Uzbekistan is the main consumer of water resources. However, due to low efficiency of the irrigation network and management, unproductive water losses are high and as a consequence, the groundwater level is elevated. Evaporation from the shallow groundwater increases the inefficient water losses in the irrigated lands. In our study we aim to estimate phreatic evaporation (EP) losses in intensively irrigated areas of the Ferghana Valley with the use of stable isotopes (Deuterium, 2H and Oxygen, 18O).
Soil samples were collected during two vegetation periods at sites that differed in soil type and groundwater level. The soil samples were taken from the surface down to the groundwater level in 5-20 cm intervals. We used a cryogenic extraction method to extract the water from the soil. Isotope signatures (δ2H and δ 18O) of the extracted water were then determined using a DLT-100 laser spectroscope. Then EP rate was calculated by fitting an exponential function to the experimental isotope soil profile.
Results of our study revealed that the EP rate is higher on sites characterized by clayey loam texture in comparison to loamy and sandy sites; and EP rates increase with the rise of the groundwater (R2=0.85-0.94). The maximum EP rates of 349 mm a-1, 245 mm a-1 and 154 mm a-1 in clayey loam, loam and sand, respectively, are observed at shallow (>1m) groundwater levels. Results of the study indicate that Ep contributes considerably to overall evaporation, with annual rates of 80 to 349 mm (6- 35% of total water losses in the water balance). Spatial patterns are yet to be investigated in order to provide recommendations for improving irrigation management in the irrigated lands of Ferghana Valley.